

Coordinating Upgrade Of The GLAD800 Drill Rig to Meet STRATAFORM Needs

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LONG-TERM GOALS

The goal of STRATAFORM is to link short-term biological and physical processes affecting sedimentation ("event" stratigraphy" developed over hours to weeks) to the stratigraphic geometry and facies distribution of the upper ~100 m of continental margin sediments representing ~10⁶ years of preserved record. This is to be realized through a coordinated program of acoustic imaging, water column and seafloor monitoring and modeling, and sub-seafloor sampling. The following summarizes efforts in 2001 to address this last goal.

OBJECTIVES

Three groups of processes have been isolated for study by STRATAFORM investigators: 1) shelf sediment dynamics and the development of lithostratigraphy; 2) slope processes and their role in shaping geomorphology; and 3) stratigraphic sequence generation. All three are linked by the goal of determining how the morphology and facies patterns of the modern sea floor (revealed by multibeam bathymetry, backscatter data, and sampling of the shelf and slope) compare with the preserved geologic record observed in seismic images and sampled in the subsurface.

APPROACH

The STRATAFORM initiative has produced outstanding results in terms of monitoring and modeling modern processes of sedimentation on the continental terrace. However, ground-truth of sub-seafloor images, collected by STRATAFORM scientists along the northern California and the New Jersey margins, is a glaringly unfulfilled goal. Sediment samples to at least 100 meters below seafloor (mbsf) are needed in both regions in order to: 1) determine what features are preserved in the sedimentary record and what processes control this selectivity; 2) gauge rates of past sedimentation processes to compare with today's, especially at times of peak glaciation when the system was vastly different from present; 3) validate predictive models of sedimentation that are currently based on modern processes; and 4) monitor in-situ properties with regards to their contributions to sediment failure.

The non-profit organization Drilling, Observation and Sampling of the Earth's Continental Crust, Inc. (DOSECC; <http://www.dosecc.org>) was established at the request of NSF to aid in the implementation of scientific drilling. This responsibility includes the design, construction and operation of specialized drilling systems. Accordingly, a portable, industrial-grade drilling rig (the "GLAD800") has been built by DOSECC for use in lakes. Because of its possible adaptation to a marine setting, the GLAD800 has attracted attention in the marine scientific community, and among STRATAFORM participants

especially. For this adaptation to happen, the GLAD800 must be modified in a cost-effective manner and must maintain its current transportable character so that it can work off of UNOLS ships. The single most important feature that must be added is an AHC to counteract swells that would otherwise generate large variations of weight-on-bit (WOB). Maintaining as uniform a WOB as possible is among the most important functions needed to reach the high core recovery that STRATAFORM requires.

Work is now underway to adapt the GLAD800 to a marine setting by installing an Active Heave Compensation (AHC) system that will minimize vertical motion of a floating platform. This will make the rig valuable to STRATAFORM scientists who have already determined objectives and have selected sample sites along both the New Jersey and the northern California margins. Funds have been provided DOSECC by the Defense University Research Instrumentation Program (DURIP) to design, build and test the AHC equipment. To be optimally useful, this rig must be able to: 1) be installed on a UNOLS platform; 2) operate in water depths as great as 150 m; 3) achieve high core recovery even in sand-prone formations; and 4) maintain adequate hole diameter for large, undeformed samples as well as for downhole logging. I have been provided funds by the ONR to monitor and coordinate the installation of an AHC capability on the GLAD800 drill rig to ensure it meets these needs of ONR in a cost-effective and timely manner.

WORK COMPLETED

The first organizational meeting of the principals (agency program managers, scientists, and DOSECC engineers) involved in this AHC development was held at ONR headquarters on Feb 21, 2001. Features of the AHC design were described and approved. Various UNOLS ships were reviewed and the R/V Knorr was selected for the initial test and possible follow-on field program because of her size, dynamic positioning capability, center well availability, and east coast location. Following this approval by ONR to proceed with these plans, a large amount of material and equipment for the AHC was ordered. A meeting between DOSECC and personnel from the WHOI port office was held in Woods Hole on March 23, 2001 to discuss installation plans of the GLAD800 rig, and to firm up to a timeline of activity and assignment of responsibilities. The completed work since that time is as follows:

- a bulletin board apprising the community of progress of AHC development was built and linked to the DOSECC web page (http://www.dosecc.org/GLAD800/Heave_Compensation/heave_compensation.html);
- a 5-day test cruise aboard the Knorr was scheduled for Nov, 5-9, 2001;
- the fine-grained surficial sediments of the 'mud patch' on the outer shelf south of Martha's Vineyard were selected for the November test area, and background sedimentologic and seismic data has been assembled;
- possible permitting issues for operating a scientific drilling/coring expedition were determined and the proper authorization has been requested from the US Army Corps of Engineers, the regulatory agency in this regard;
- the R/V Knorr logged vertical reference data from its AshTech system and forwarded it to DOSECC as a sample of ship response to various sea states;

- AutoCad drawings of the R/V Knorr were provided to DOSECC;
- all material, ranging from raw steel to high-pressure hoses to pre-built hydraulic power packs to computers was selected, ordered and received by DOSECC;
- the first assembly of the AHC at the DOSECC facility has been completed;
- station-keeping ability of the R/V Knorr is scheduled to be logged during a 5-day deployment in late September, 2001 in an area close to the November test site.

RESULTS

The sea trials for the AHC-equipped GLAD800 are scheduled for Nov. 5-9, 2001. It will be known then how well this system performs and if it can satisfy the sampling needs of STRATAFORM. If the test is positive, it is expected that at least 22 days of continuous coring will be conducted on the NJ shelf from the R/V Knorr in 2002.

IMPACT / APPLICATIONS

If successful, an AHC-equipped GLAD800 drill/core rig will provide STRATAFORM and the rest of the scientific community the first chance to continuously sample shallow (<75 m) water sediments from more than 10 m below the seafloor. There is an enormous range of processes that currently cannot be assessed from the geologic record for the simple fact that we cannot recover undisturbed samples in adequate volume. Among these processes are: the impact and frequency of storms on the sedimentary record; the agents that move sediment across the continental shelf; the frequency and triggers of massive submarine slides at the edge of the continental shelf; the cause of local as well as shelf-wide acoustic reflections within the sediment column.

TRANSITIONS

If the November, 2001 test is successful, future drilling/coring with the AHC-equipped GLAD800 from the Knorr or other UNOLS vessels will provide many new opportunities to sampling the shallow-water stratigraphic record. It is likely to be of interest to activities funded by the ONR, the Ocean Sciences Division of the National Science Foundation, and the Integrated Ocean Drilling Program.

RELATED PROJECTS

The interest in sampling the continental terrace is not limited to investigators in the U.S. Europeans, in discussion with STRATAFORM scientists, have determined that parallel interests could be served with shallow-water sampling along the Rhone and the Po River margins of France and Italy. A proposal to drill and core these areas using several platforms that could include the GLAD800 is nearing completion by a team of European and North American scientists, and will be submitted to the European Union towards the end of 2001.